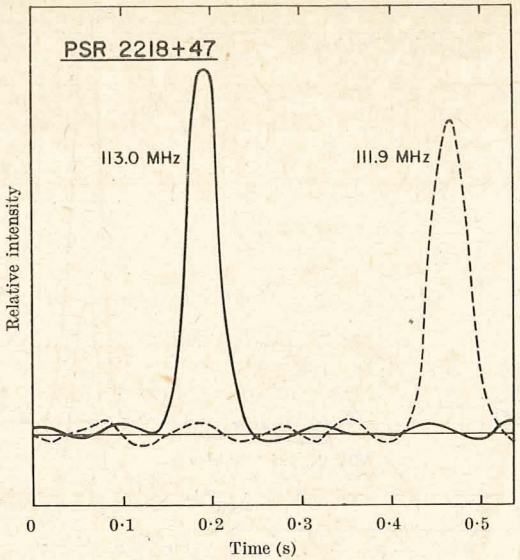

Fig. 2. Mean pulse profiles for *PSR* 2218+47, observed on January 1, 1969, simultaneously at 111·9 MHz and 113·0 MHz. A total of 20 min of data were averaged together, with an assumed heliocentric period of 0·538461 s. Effective time resolution is about 40 ms, including the effect of dispersion.

in time of the pulses in the two receiver channels indicates an integrated electron density along the line of sight of $43{\cdot}8 \pm 0{\cdot}2$ cm^{-3} pc.

We thank L. Goad and M. Jura of Harvard University, A. Hartai and A. Rodman of the University of Massachusetts, and the staff of the US National Radio Astronomy Observatory for their assistance. This work was supported by the US National Science Foundation and by the US National Aeronautics and Space Administration.

Received February 18, 1969.

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Printed in Great Britain by Fisher, Knight & Co., Ltd., St. Albans.

(Reprinted from *Nature*, Vol. 221, No. 5183, pp. 816–817, March 1, 1969)

Two New Pulsating Radio Sources

Two new pulsars have been discovered and their parameters measured

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Two new pulsars have been discovered during a search for such objects carried out with the 300 foot transit telescope at the US National Radio Astronomy Observatory during October and November 1968. The new sources have been designated *PSR* 0904+77 and *PSR* 2218+47, in accordance with the system of nomenclature suggested by Turtle and Vaughan[1], but these designations should be considered tentative until more accurate position measurements become available. The positions and other measured parameters of the two sources are listed in Table 1.

The searching technique used was similar to that used by Huguenin *et al.*[2] in the discovery of *HP* 1506. The antenna was driven back and forth in declination at a rate of 2·5 arc degrees min^{-1}, tracing out a zigzag pattern across the sky. In this way, a declination strip of width approximately 10/cos δ arc degrees was covered each day, and each location within any such strip was inside the 2 degree main beam of the antenna for about 1 min. The survey included the entire declination range $+44° < \delta < +85°$, in addition to the range $-19° < \delta < -8°$ for right ascensions between 5 h and 14 h. Each strip was scanned at least three times, and many of the regions were covered as many as ten times.

Two receivers were operated simultaneously, tuned respectively to frequencies of about 110 MHz and 112 MHz. Each had a bandwidth of 0·3 MHz, and the output of each was sampled and recorded on magnetic tape once every 20 ms. An off-line computer searched the recorded data for pulsating signals with periods in the range 0·16

Table 1. MEASURED PARAMETERS OF THE PULSARS

	PSR 0904+77	*PSR* 2218+47
Right ascension (1950·0)	09 h 04 m ± 10 m	22 h 18·3 m ± 1·0 m
Declination (1950·0)	+77° 40′ + 50′	+47° 30′ ± 30′
Galactic longitude	135°	98°
Galactic latitude	+34°	−8°
Heliocentric period (s)	1·57905 ± 0·00006	0·538461 ± 0·000008
Integrated electron density (cm^{-3} pc)	—	43·8 ± 0·2
Mean pulse energy at 110 MHz (J m^{-2} $Hz^{-1} \times 10^{-26}$)	~0·15	~0·7
Mean flux density at 110 MHz (W m^{-2} $Hz^{-1} \times 10^{-26}$)	~0·1	~1·3
Pulse width (ms)	<80	<30

to 5·0 s. The computer analysis involved (*a*) separating the data from each receiver into groups of 2,048 consecutive samples; (*b*) computing the Fourier transform of each such group; (*c*) searching the transform for Fourier components which, averaged together with their harmonically related counterparts, significantly exceeded the mean level of the Fourier transform. When this test produced a significant result, thus indicating a probable pulsar period, the computer then (*d*) cross-correlated the original sets of 2,048 data points with a train of uniform pulses spaced by the indicated period. Finally, (*e*) the resulting cross-correlation functions were tested for the presence of a significant "average pulse".

In scanning the sky no attempt was made to avoid the positions of the already known pulsars. Thus these sources were frequently detected as possible "new" pulsars by the computer analysis and they provided a built-in empirical test of the sensitivity and reliability of the searching technique and therefore of the completeness of the survey. We believe it unlikely that any undiscovered pulsars remain within the region covered by the present survey, unless (*a*) their periods fall outside the range 0·16 to 5·0 s; (*b*) their dispersion measures are greater than about 50 cm^{-3} pc; or (*c*) their mean flux densities at 110 MHz are smaller than about $0{\cdot}3 \times 10^{-26}$ W m^{-2} Hz^{-1}, or about one-half the average flux density of *HP* 1506. These parameters define a three-dimensional "window" in period-dispersion-intensity space, through which the survey was capable of observing pulsars.

PSR 0904+77 has some peculiar characteristics that make it of special interest. On most occasions when reasonably strong pulses were received from this source, there was evidence of a secondary pulse, approximately 20 per cent the amplitude of the main pulse, spaced midway between the main pulses. The secondary pulses are evident in the two curves shown in Fig. 1, each of which represents the mean pulse profile observed from *PSR* 0904+77 over a period of about 25 min on a particular day. An alternative interpretation of these curves is that the true period of this pulsar is one-half of the value quoted in Table 1, or 0·789525 s, and that there is a strong

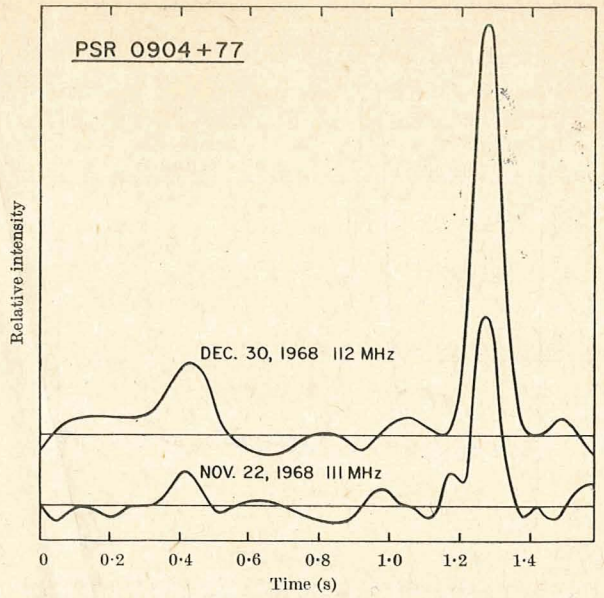

Fig. 1. Mean pulse profiles for *PSR* 0904+77, observed on November 22 and December 30, 1968. Each curve is the average of about 25 min of data; it is assumed that the correct heliocentric period is 1·57905 s. Effective time resolution is 50 ms, not including possible effects of dispersion.

modulating mechanism present which enhances every alternate pulse. We believe that either of these interpretations is more easily accounted for by a rotating model[3,4] than by a pulsating model[5].

The pulses from *PSR* 0904+77 show intensity variations of at least an order of magnitude over frequencies as close together as, say, 111 and 112 MHz. In fact, dual-frequency observations of this source have been attempted on several days, and in no case has the source been detected simultaneously on two different frequencies. For this reason, we have been unable to measure the dispersion of *PSR* 0904+77. It is not yet clear whether spectral structure of this type, which has been observed for other sources as well, is an emission phenomenon inherent in the pulsars themselves or a scintillation phenomenon occurring in the medium between the observer and the source[6–8].

PSR 2218+47 shows no significant emission between the main pulses. Mean pulse profiles for this source are shown in Fig. 2, from data obtained on January 2, 1969, averaged over a period of about 20 min. The displacement